INVESTIGATION OF ANTIOXIDANT CAPACITY AND MINERAL CONTENT OF DIFFERENT TEA SAMPLES

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Abstract
The consumption of various teas and herbal teas is undergoing a renaissance. They are used for the prevention and cure of various diseases and for pleasure. The herbal parts of teas all have valuable nutritional values, which have excellent antioxidant effect, free radical scavenging properties. The beneficial health effect is due to the polyphenols and the rich mineral element content. During the experiment the polyphenol content and antioxidant capacity of the infusions made from green tea, cranberry, rooibos, honey bush, lemongrass, milfoil and nettle tea, were investigated. The mineral content of the plant parts and teas was also measured. A close correlation was found between polyphenol content and antioxidant capacity indicating the protective role of polyphenols. The antioxidant capacity and polyphenol content of lemongrass and green tea is outstanding compared to the other teas studied, honey bush and nettle showed the smallest content. For magnesium and calcium supplements the cranberry tea is best proposed, For manganese complement it is worth drinking green tea. Lemon grass, cranberry and green tea are the most important phosphorus source. In case of iron deficiency, cranberry tea is recommended, while lemongrass and honey bush tea are the most suitable for zinc supplementation. The results may also have been influenced by the preparation habits, such as the temperature of water or soaking time.

Introduction
Tea has been known since ancient times, it spread in China, thanks to Emperor Sen-nung b.C in 2727. The first teas were the extract of dried leaves of *Camellia sinensis* (L.) Today the naming of tea covers up, traditional teas, green, black, rooibos, while mate teas include different herbal teas, as chamomile, lemongrass, milfoil, nettle etc.
The valuable ingredients of tea - for example flavonoids - are suitable for the prevention and cure of diseases [1, 2, 3]. Free radicals are in the background of many diseases [3, 4, 5, 6, 7] which are formed under biotic and abiotic stress effects [8,9].In the protection against free radicals play an important role a multitude of low molecular weight molecules, such as vitamins, carotenoids, flavonoids. [10,11,12]. Above all, the rich mineral element content of teas should also be mentioned, hereby teas have a positive effect indirectly [13,14,15,16].

Materials and Methods
Samples
Extracts were made from commercially available samples, they were as follows: green tea (*Camellia sinensis* L.), cranberry (*Vaccinium oxycoccos* L.), rooibos, (*Aspalathus linearis* L.), honeybush (*Cyclopia intermedia* L.), lemongrass (*Melissa Officinalis* L.), milfoil (*Achillea millefolium* L.) and nettle (*Urtica dioica* L.).

The sample preparation was performed according to instructions in *Table 1.*, and the results were converted to 1 g.

Table 1. Preparation of tea samples

Samples	Preparation	Cooking time (min)
green tea (filters)	1 filter + 200 ml 100°C water	3
cranberry (filters)	1 filter + 200 ml 100°C water	5
rooibos (bag)	teaspoon + 300 ml 100°C water	10
honeybush (bag)	teaspoon + 300 ml 100°C water	10
lemongrass (bag)	1 g + 100 ml 100°C water	10
milfoil (bag)	1 g + 100 ml 100°C water	10
nettle (bag)	1 g + 100 ml 100°C water	10

Cooled extracts were centrifuged at 13000 rpm for 10 min at room temperature. The analytical measurements were carried out from pure supernatant.

Determination of antioxidant capacities by FRAP (Ferric Reducing Antioxidant Power) method

Measurement of ferric reducing antioxidant power of the fruit extracts was carried out based on the procedure of Benzie and Strain [17], at 593 nm. (Spectronic Helios Gamma UV Visible Spectrophotometer Thermo Fisher Scientific.) Ascorbic acid (AA) was used as a standard to prepare the calibration solutions. Results were expressed as μMAA/g of dry plant material.

Determination of total phenolic contents by Folin-Ciocalteu method

The Folin - Ciocalteu method is an electron transfer based assay and gives reducing capacity which is expressed as phenolic content. Total phenolic content of the fruit extracts was determined with the Folin-Ciocalteu reagent according to a procedure described by Singleton and Rossi [18], at 760 nm.

Gallic acid (GA) was used as a reference standard to prepare the calibration solutions. The results were expressed as mMGA/g of dry plant material.

Mineral content analysis using ICP-OES

The presence of the following minerals: Ca, Mg, K, Na, Fe, Cu, Zn, Mn and P was investigated by inductively coupled plasma optical emission spectrometry (ICP-OES).

All the previously freeze-dried samples were prepared for the analysis via microwave digestion method by using concentrated nitric acid and hydrogen peroxide.

After mineralization, the resulting solutions were cooled to room temperature, then they were transferred to autosampler tubes and diluted to a final volume of 25 mL with Milli-Q water. The determination of mineral contents in this clear solution was carried out by ICP-OES (Perkin Elmer Optima 8000). The concentrations of the calibration solutions were in the range from 1 to 100 mg/kg (1, 5, 10, 100 mg/kg, respectively) to match the amount of the elements possibly present in the samples.

Results and discussion

In the experiment the polyphenol content and antioxidant capacity of the infusions made from green tea, cranberry, rooibos, honey bush, lemongrass, milfoil and nettle tea, were investigated. As a results show, the polyphenol content of the samples are directly proportional to the antioxidant capacity, which proves that the polyphenols play an important role in the antioxidant protection system of the organism. The antioxidant capacity and the polyphenol content of lemongrass and green tea are extremely high, these parameters of

honeybush and nettle are relatively low. The rooibos-, cranberry- and milfoil teas have an average antioxidant capacity. (*Fig 1,2*).

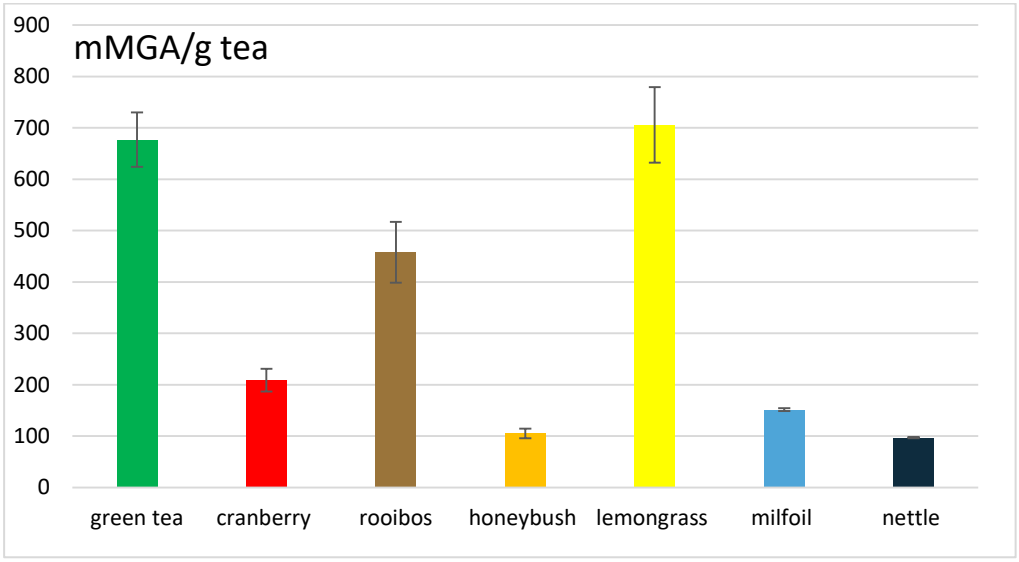

Figure 1. Polyphenolic content in the different teas (mMGA/g dry tea)

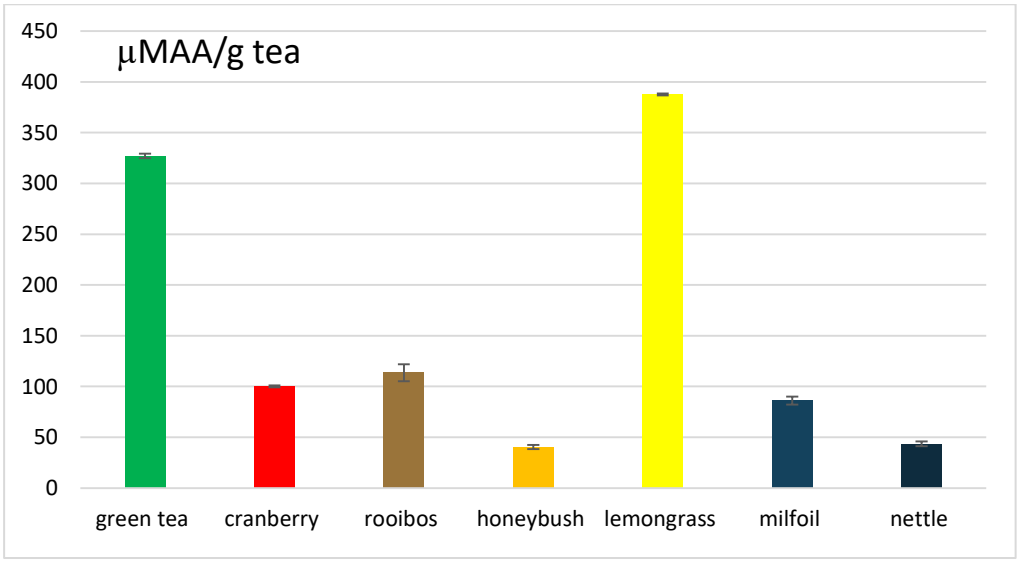

Figure 2. Antioxidant capacity in the different teas (µMAA/g dry tea)

The rooibos and honeybush have a relatively high sodium and low potassium content as a result of soil content of South Africa. Consumption of these kind of influences is undedicated for person with kidney disease, because of their not optimal sodium-potassium rate. As a result of our experiments can be stated, that for manganese complement it is worth drinking green tea. Lemon grass, cranberry and green tea are the most important phosphorus sources. In case of iron deficiency, cranberry tea is recommended, while lemongrass and honey bush teas are the most suitable for zinc supplementation.

Table 2. Element content of different dry teas (mg/kg)

	Ba	**Ca**	**Fe**	**K**	**Mg**	**Mn**	**Mo**	**Na**	**P**	**Sr**	**Zn**
Lemongrass	36	**13300**	190	**27000**	**5050**	29	**2**	800	**2400**	**46**	25
Cranberry	**69**	7400	**290**	13000	1900	180	<0.5	75	1150	44	20
Green tea	58	6300	170	15000	1900	**1300**	<0.5	18	1900	24	30
Rooibos	8	2600	150	5200	1800	72	<0.5	**6000**	450	20	**65**
Honeybush	17	2500	110	3800	930	40	<0.5	2400	260	37	50

Table *3. Element content of different infusion of teas (mg/L)*

	Ba	**Ca**	**Fe**	**K**	**Mg**	**Mn**	**Mo**	**Na**	**P**	**Sr**	**Zn**
Lemongrass	0.01	<0.1	0.02	**160**	1.2	0.02	<0.1	8.2	**5.1**	<0.01	**0.3**
Cranberry	**0.2**	**22**	**0.2**	100	**3.4**	0.8	<0.1	<0.1	4.6	**0.05**	0.2
Green tea	0.01	<0.1	0.03	102	1.6	**2.2**	<0.1	<0.1	4.2	<0.01	0.1
Rooibos	<0.01	<0.1	0.04	17	<0.02	0.06	<0.1	**27**	0.3	<0.01	0.2
Honeybush	0.01	<0.1	0.05	16	<0.02	0.03	<0.1	15	0.2	<0.01	**0.3**

Conclusion

The teas have a positive physiological effect thanks to their extremely high antioxidant capacity. However the results may also have been influenced by the preparation habits, such as the temperature of water or soaking time.

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